





# Intel Developer FORUM



# **Justin Rattner**

## **Senior Fellow**

## **Chief Technology Officer**

Intel Developer  
**FORUM**



**Imagine what can be**  
**Create what will be**





# FOR DEVELOPERS BY DEVELOPERS

Chalk Talks  
Shop Talks

## Wednesday Technology Insights

### Extracting The Most Out Of Intel's Multi-Core Platforms



**Richard Wirt**  
Intel Vice President, Senior Fellow  
General Manager - Software and Solutions Group

### Intel's Next Generation Microarchitecture



**Steve Pawlowski**  
Intel Senior Fellow, Digital Enterprise Group Chief Technologist

**Ofri Wechsler**

Intel Fellow, Director





# Energy: The Next Frontier



# The Classic Tradeoff

Higher  
Top Speed and Acceleration

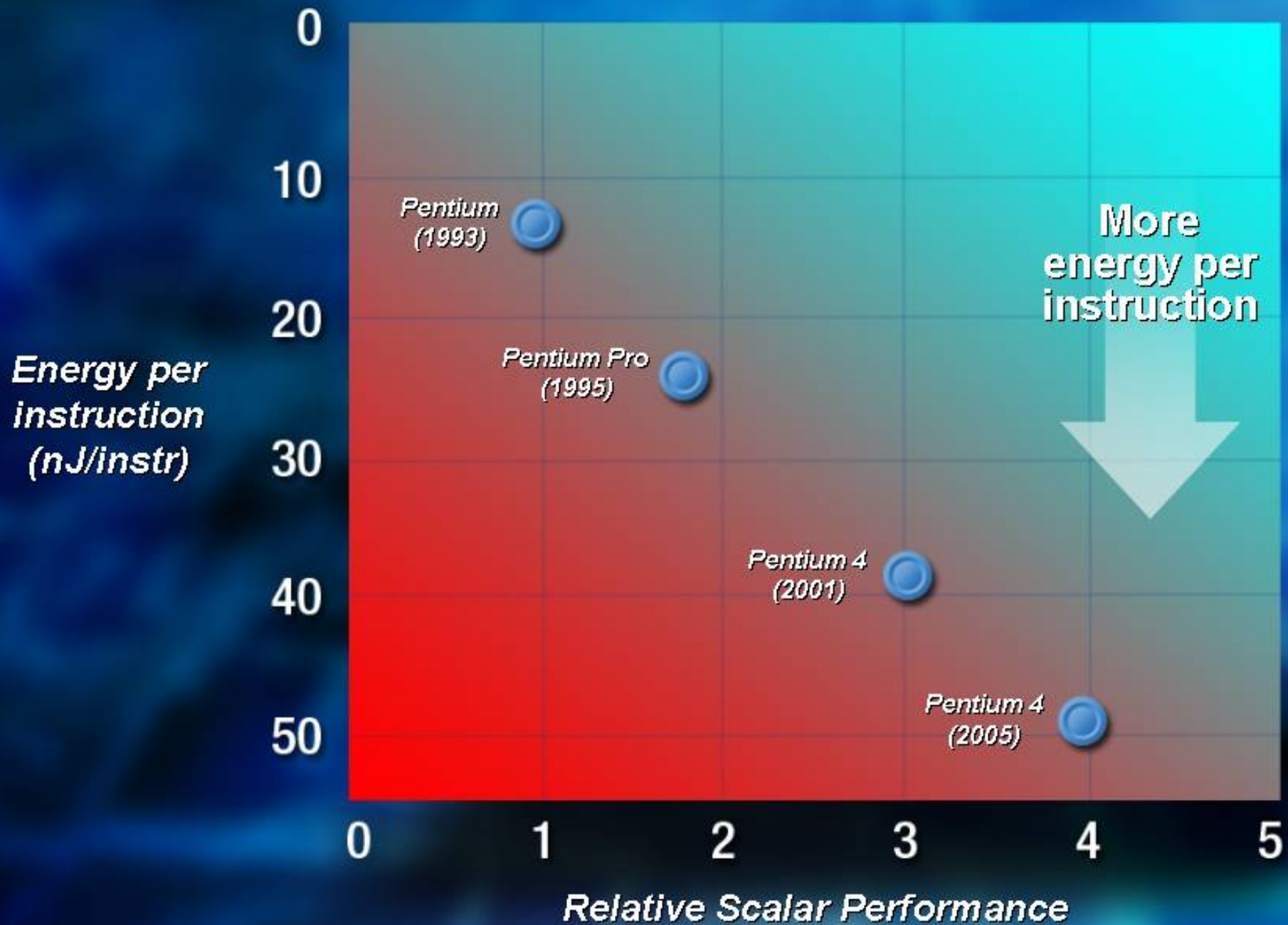
Increased  
Range and Economy

**OR**



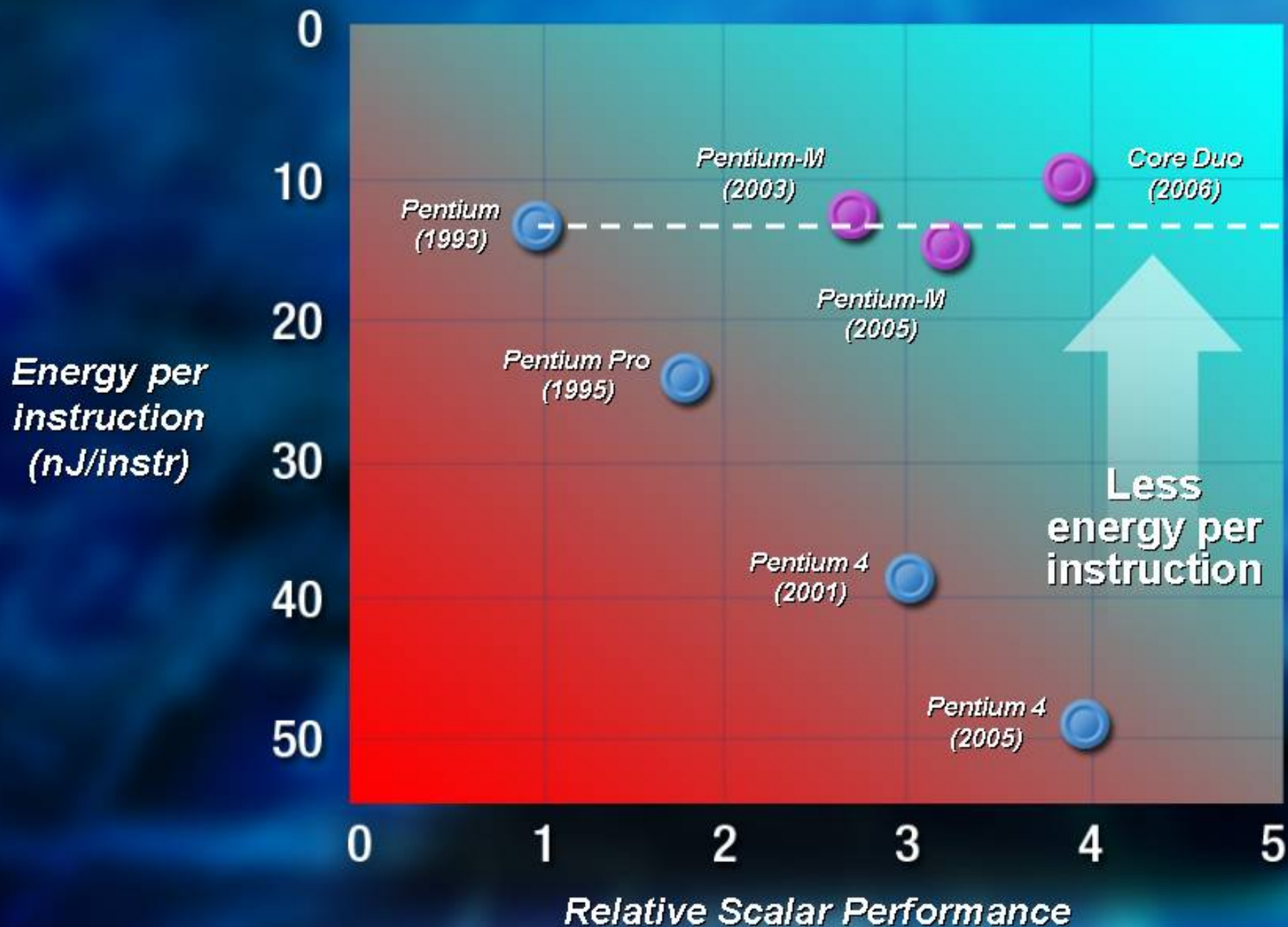


# No Way Out?





# Breaking Through the Power Wall



# The Real Challenge

Capabilities



Performance



Energy-Efficiency





**Energy-Efficient  
Performance**



**Critical  
Capabilities**

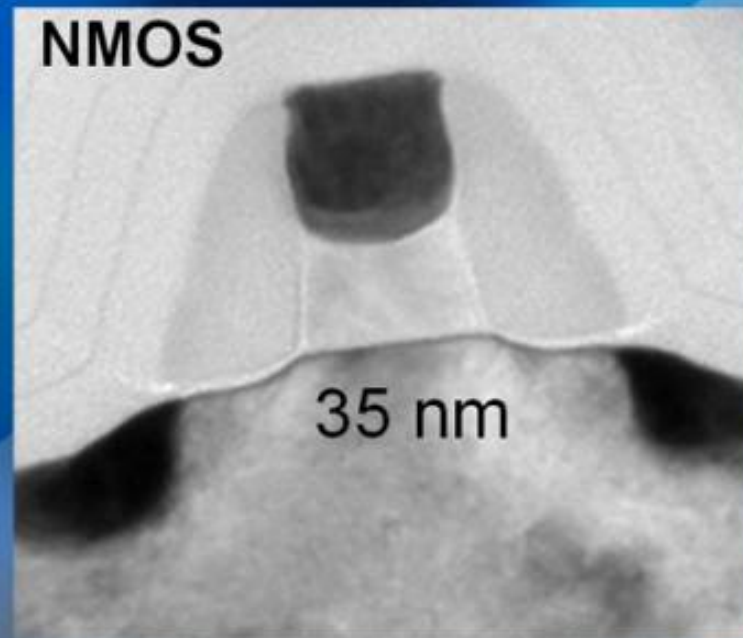
# **Intel® Core™ Microarchitecture**

**Next-Generation Processors  
for Mobile, Desktop and Server**

# High Volume 65nm

TRANSISTOR  
PERFORMANCE

20%



SWITCHING  
POWER

30%

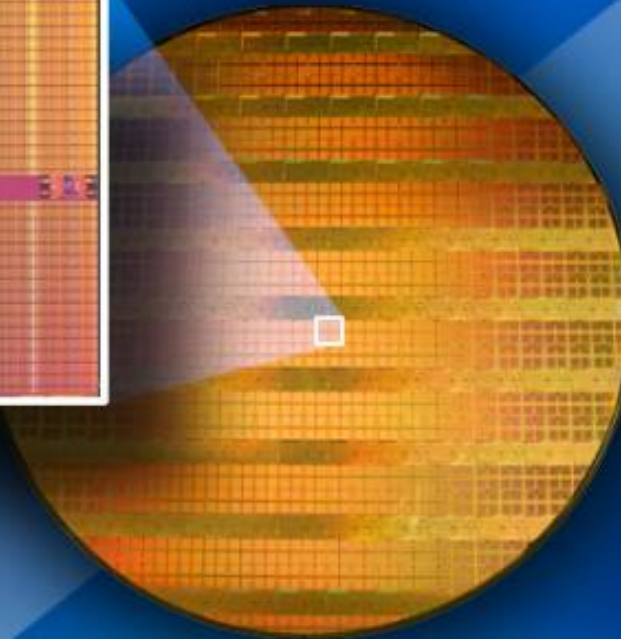
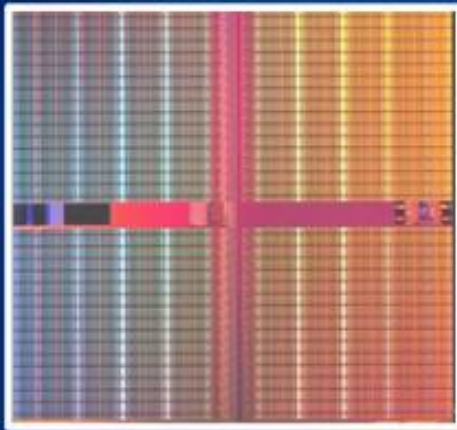
*...relative to  
Intel 90nm process*



# 45nm in 2007

TRANSISTOR  
PERFORMANCE

20%



SWITCHING  
POWER

30%

*...relative to  
Intel 65nm process*

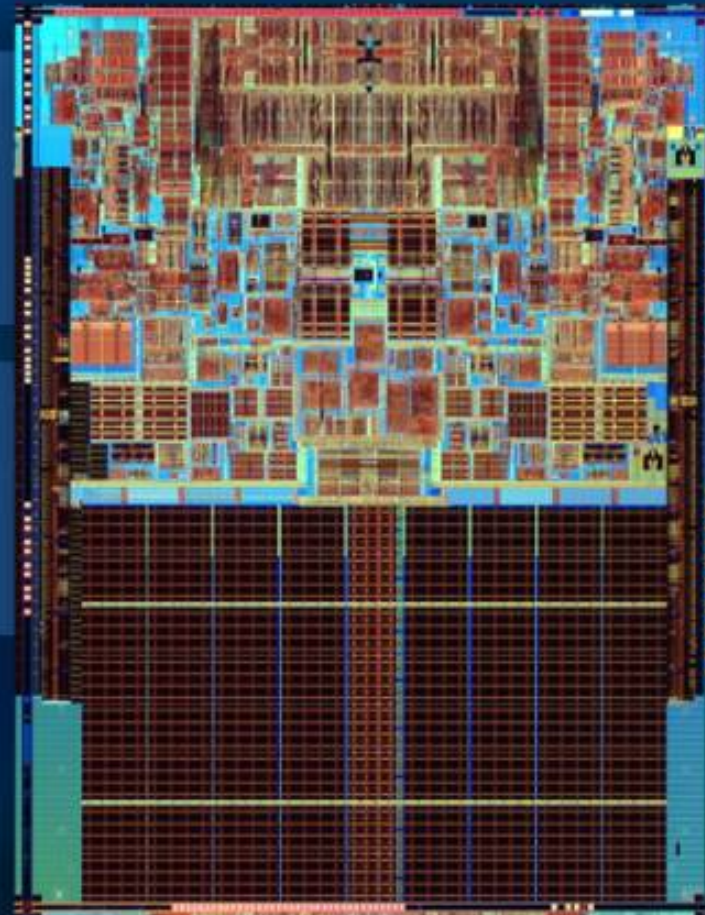
# Five Key Innovations

**Intel® Wide  
Dynamic Execution**

**Intel® Intelligent  
Power Capability**

**Intel® Advanced  
Digital Media Boost**

**Intel® Smart  
Memory Access**



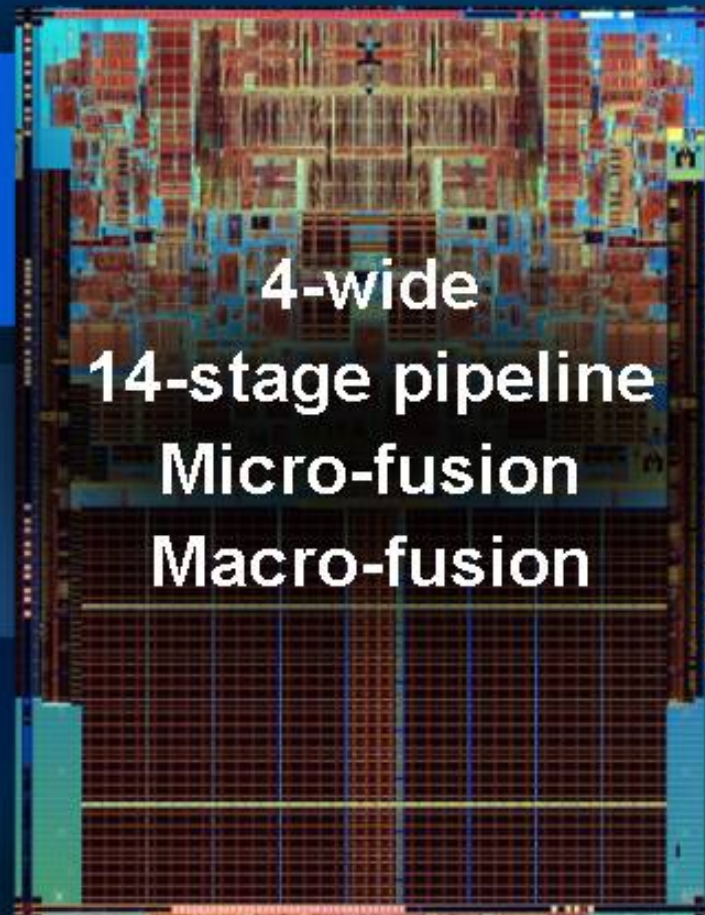
**Intel® Advanced  
Smart Cache**



# Five Key Innovations

**Intel® Wide  
Dynamic Execution**

**Intel® Advanced  
Digital Media Boost**



**Intel® Intelligent  
Power Capability**

**Intel® Smart  
Memory Access**

**Intel® Advanced  
Smart Cache**

# Five Key Innovations

Intel® Wide  
Dynamic Execution

**Intel® Advanced  
Digital Media Boost**



**Single-cycle  
128-bit SSE**

Intel® Intelligent  
Power Capability

Intel® Smart  
Memory Access

Intel® Advanced  
Smart Cache



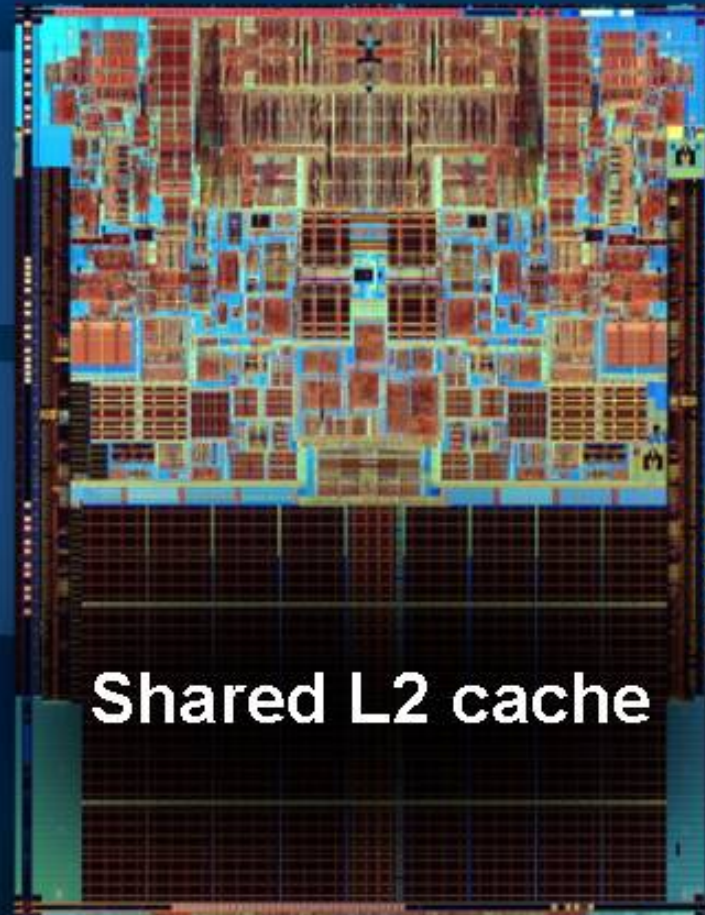
# Five Key Innovations

Intel® Wide  
Dynamic Execution

Intel® Intelligent  
Power Capability

Intel® Advanced  
Digital Media Boost

Intel® Smart  
Memory Access



Shared L2 cache

Intel® Advanced  
Smart Cache

# Five Key Innovations

Intel® Wide  
Dynamic Execution

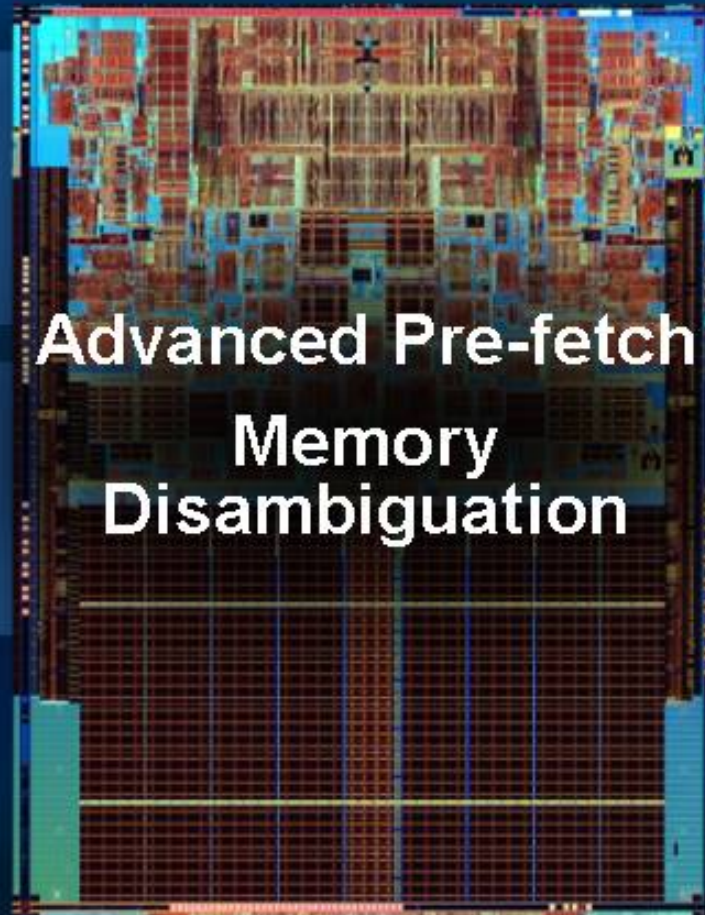
Intel® Intelligent  
Power Capability

Intel® Advanced  
Digital Media Boost

Intel® Smart  
Memory Access

Advanced Pre-fetch  
Memory  
Disambiguation

Intel® Advanced  
Smart Cache

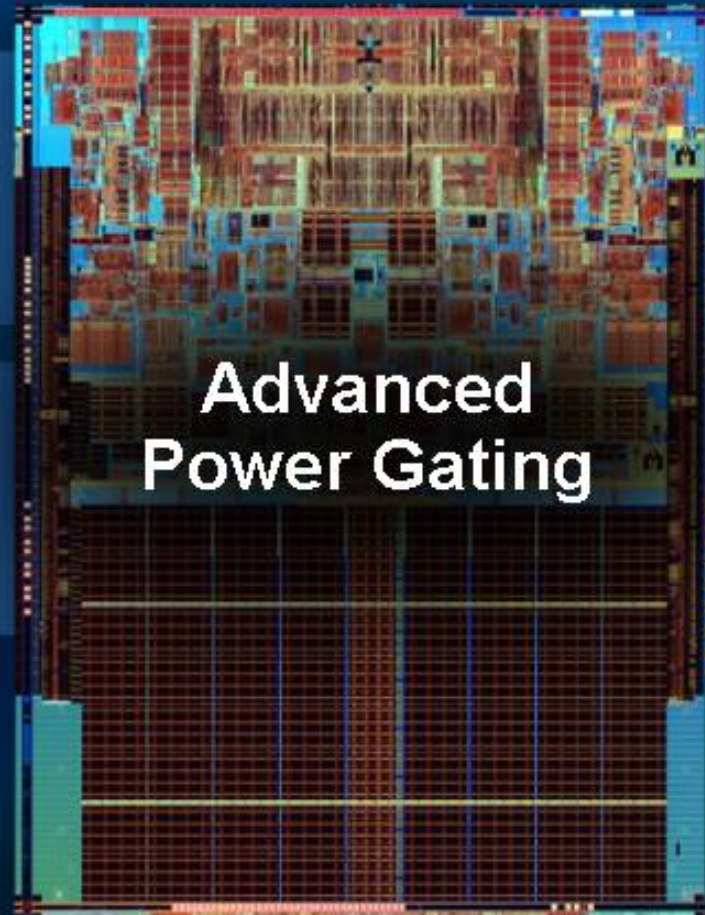




# Five Key Innovations

Intel® Wide  
Dynamic Execution

Intel® Advanced  
Digital Media Boost



Advanced  
Power Gating

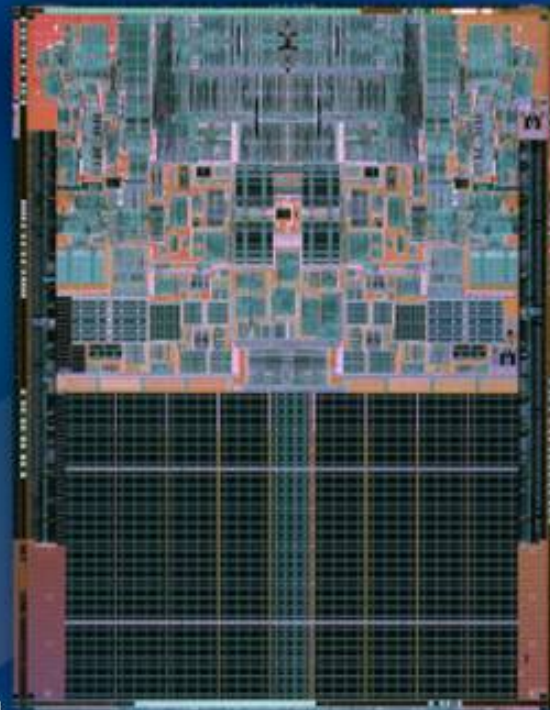
Intel® Intelligent  
Power Capability

Intel® Smart  
Memory Access

Intel® Advanced  
Smart Cache

# Merom for Mobile

PERFORMANCE  
**>20%**



BATTERY LIFE  
**Constant**

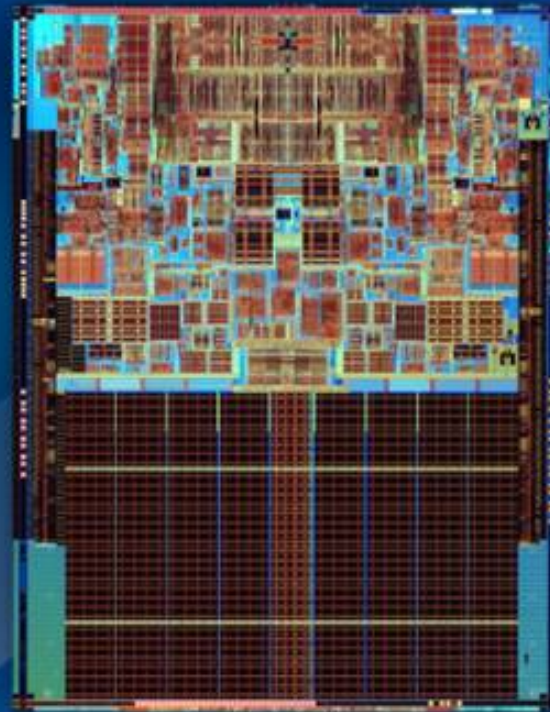
*...relative to  
Intel® Core Duo™ T2600*



# Conroe for the Desktop

PERFORMANCE

40%



POWER  
40%

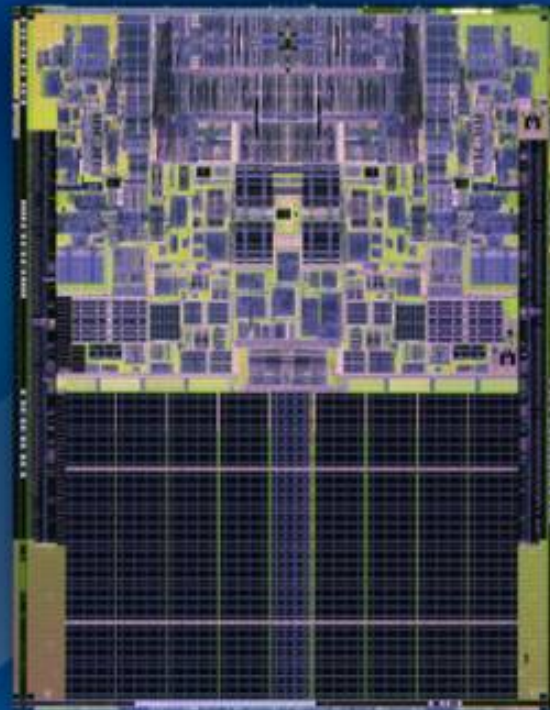
*...relative to  
Intel® Pentium® D 950*

Source: Intel based on estimated SPECint\*\_rate\_base2000 and thermal design power

# Woodcrest for Servers

PERFORMANCE

80%



POWER  
35%

*...relative to  
Intel® Xeon® 2.8GHz 2x2MB*

Source: Intel based on estimated SPECint\*\_rate\_base2000 and thermal design power

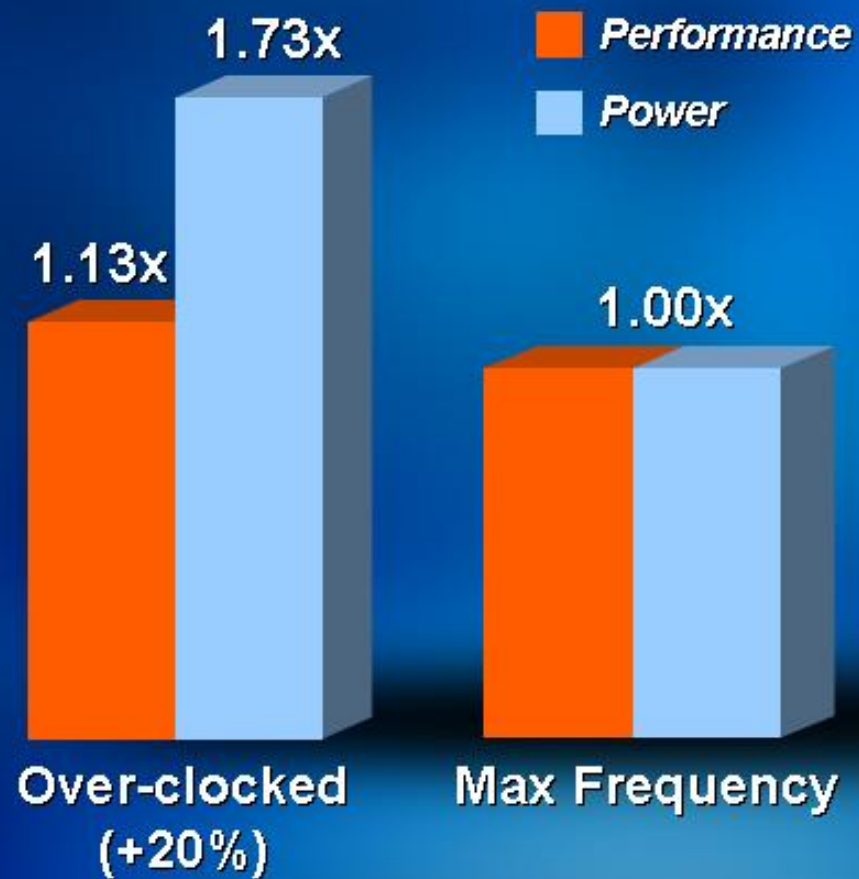


# Why Multi-Core?



*Relative single-core frequency and Vcc*

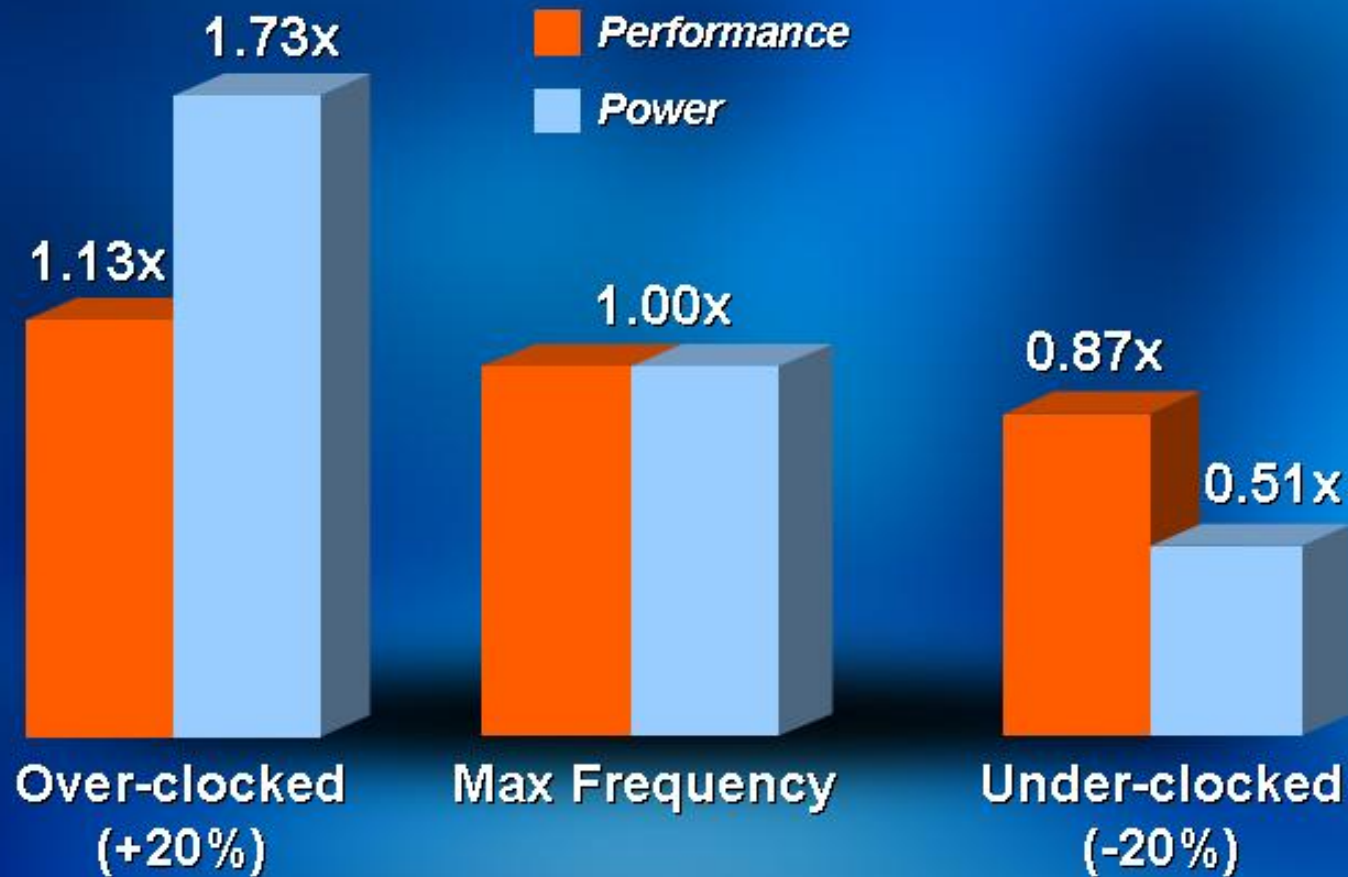
# Over-clocking



*Relative single-core frequency and Vcc*

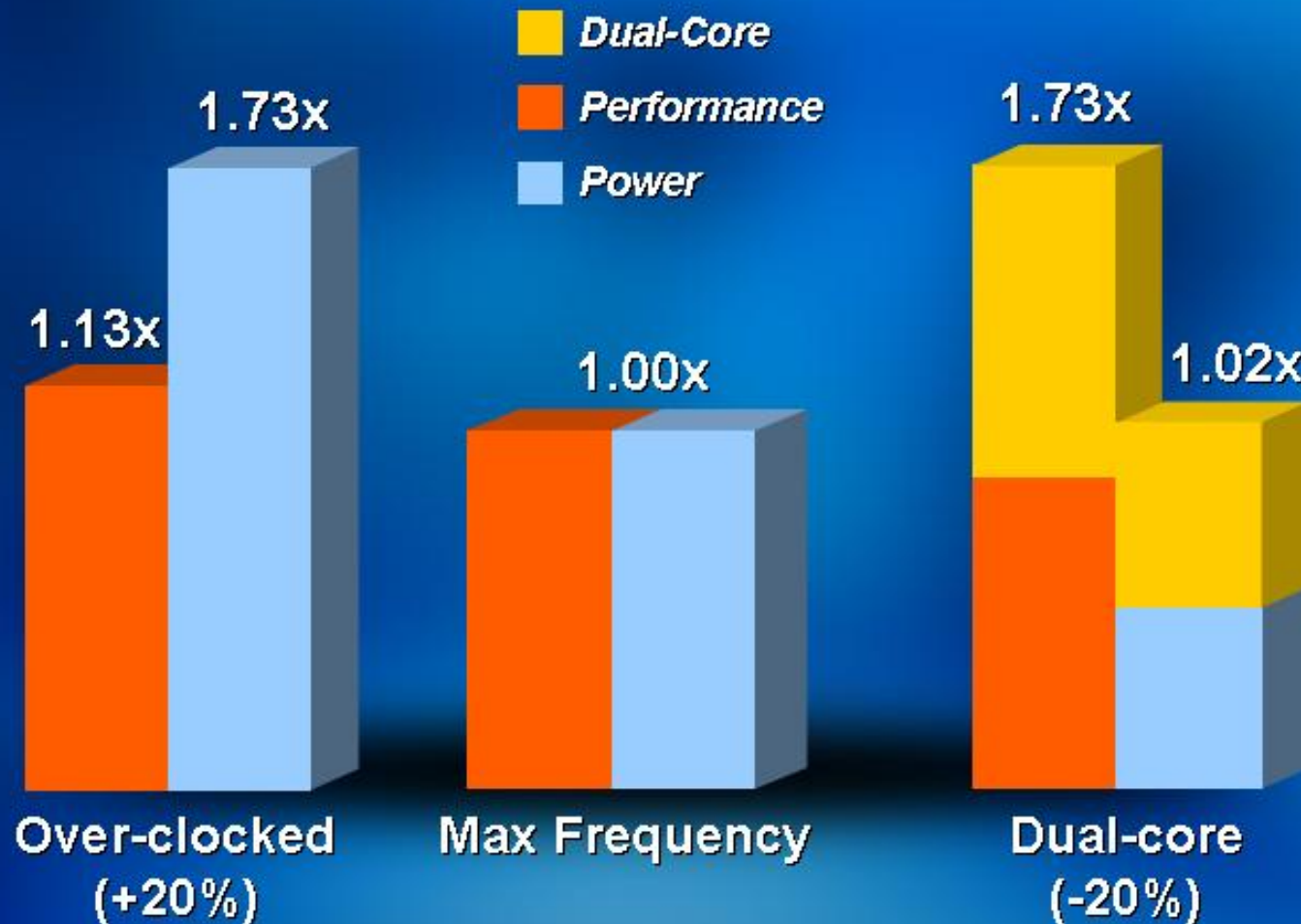


# Under-clocking



*Relative single-core frequency and Vcc*

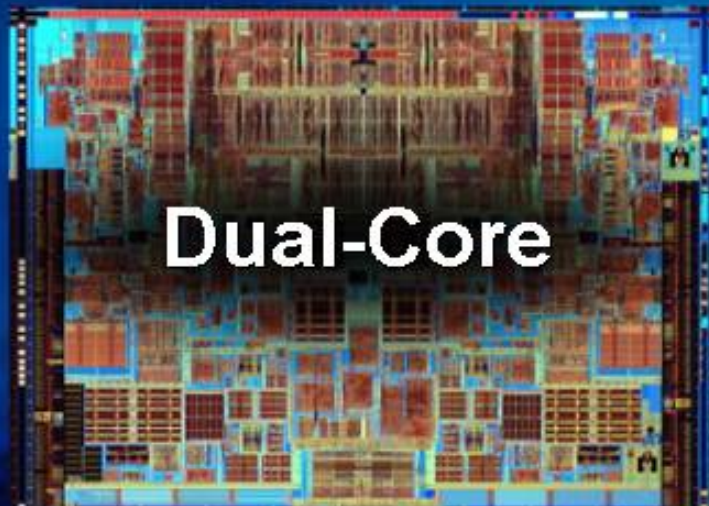
# Multi-Core Energy-Efficient Performance



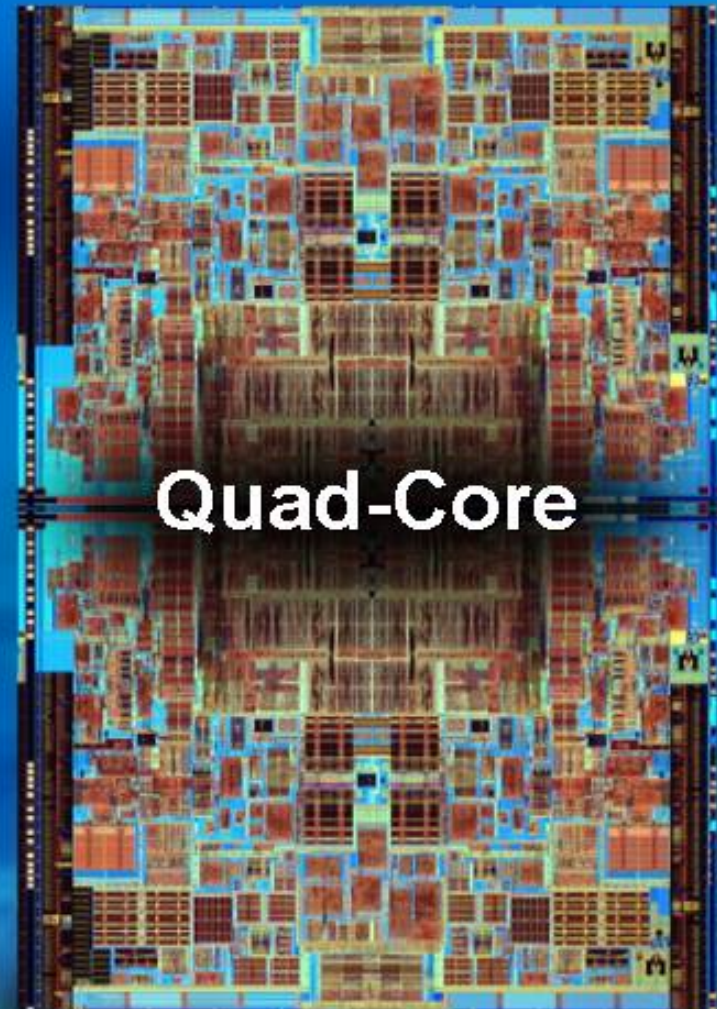
*Relative single-core frequency and Vcc*



# Multi-Core Trajectory



2006



2007

# Enabling Multi-Threaded Software

Automatic Loop  
Parallelization

Critical Path Analysis  
with Thread Profiler

Load Balancing  
with VTune™

Optimized  
MKL and IPP Libraries





# Multi-threading Momentum



Activision (Ravensoft)	Pinnacle
Adobe	Pixar (Renderman)
Algorithmics	Paradigm
Alias	PTC
Autodesk	Red Hat
Business Objects	SAP
Cakewalk	SAS
CodecPeople	Siebel CRM
Computer Associates	Signet
Corel (WordPerfect)	Skype
Cyberlink	SLB
Discreet	SnapStream
IBM	Sonic (Roxio)
id Software	Sony
Landmark	Steinberg
Macromedia	SunGard
Mainconcept	Sybase
Maxon	Symantec
mental images	Thomson
Microsoft (Office Suite)	THQ
Midway	Ubisoft
MSC	UGS
Novell SUSE	Valve
Oracle	Yahoo (Musicmatch)
Pegasus	

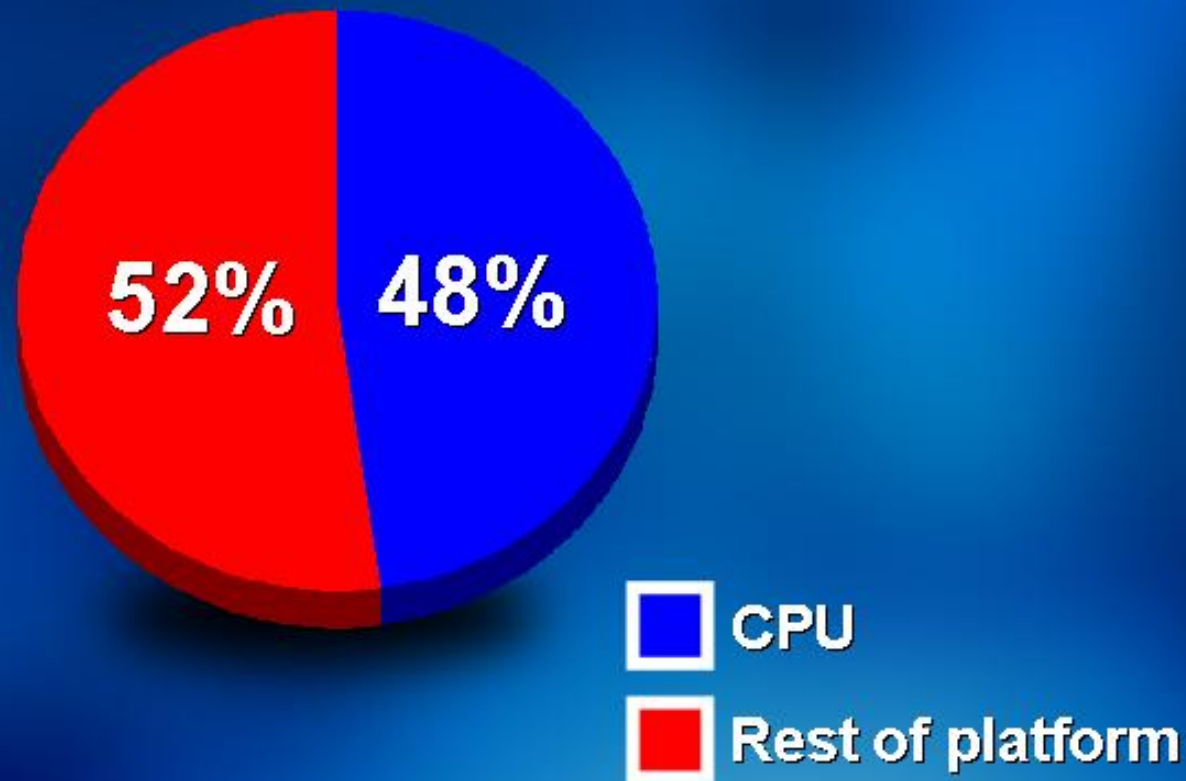
- 
- A woman with glasses is visible on the left side of the image, looking towards the right. The background is a blue gradient with a faint cityscape. A blue rectangular box with a gradient is tilted and contains a list of three items, each preceded by a white checkmark in a square box.
- ✓ Core™ microarchitecture
  - ✓ Multi-core processors
  - ✓ Multi-threaded software

**Are we done?**



# Today's Platform Even Split

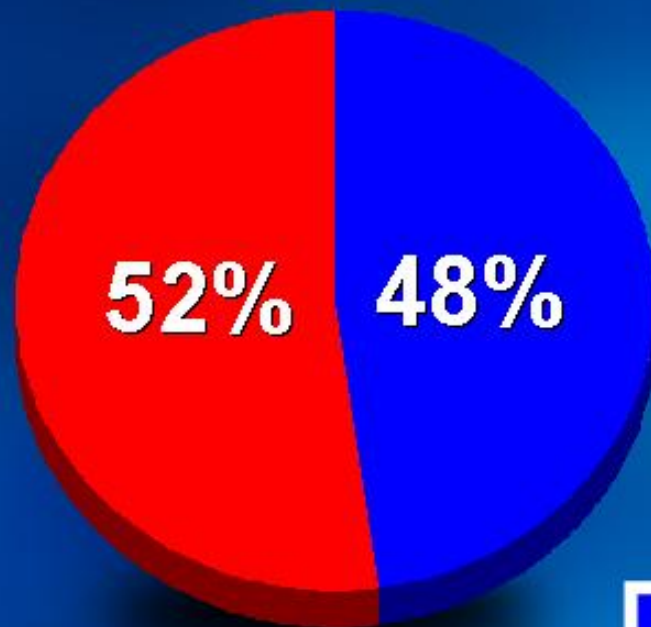
*Today's Typical  
Server*



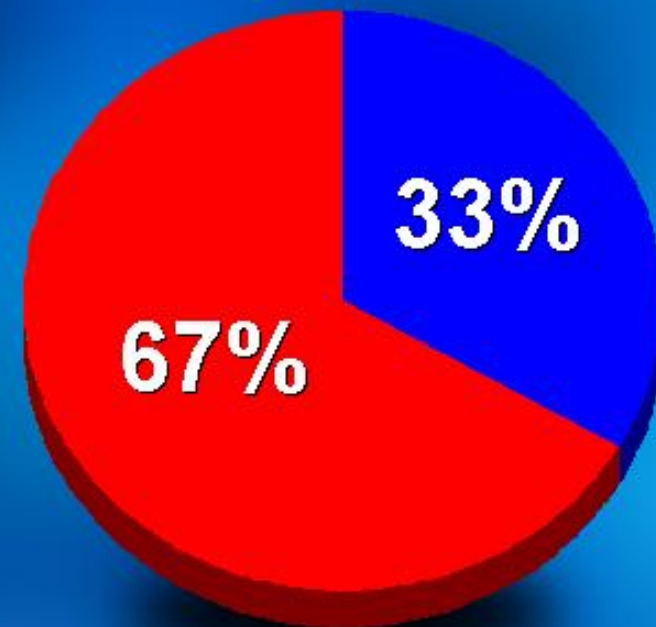
Based on power consumption running SPECint\_rate2000

# Tomorrow's Platform Demands

*Today's Typical Server*



*Woodcrest Server*



CPU

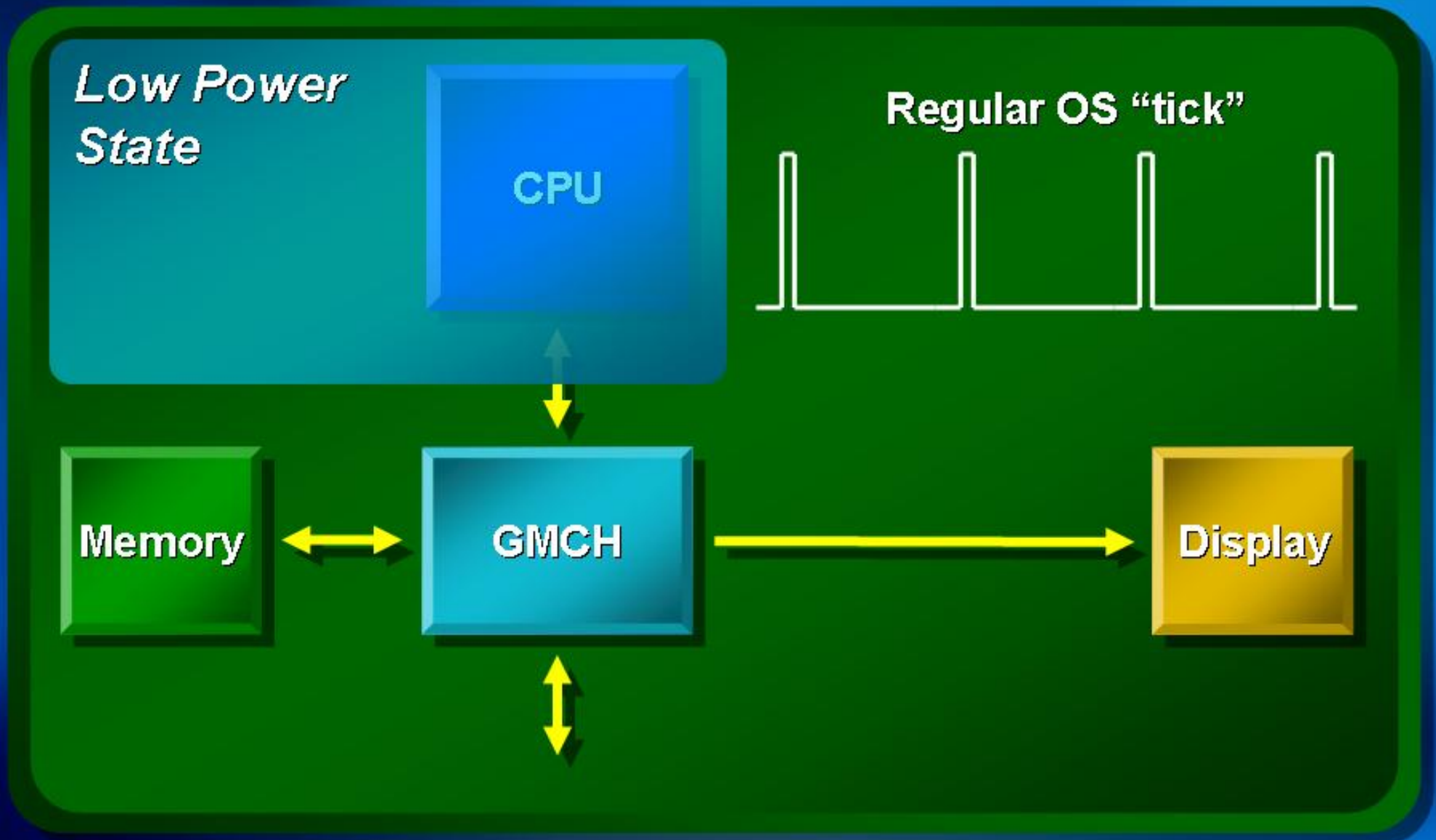


Rest of platform

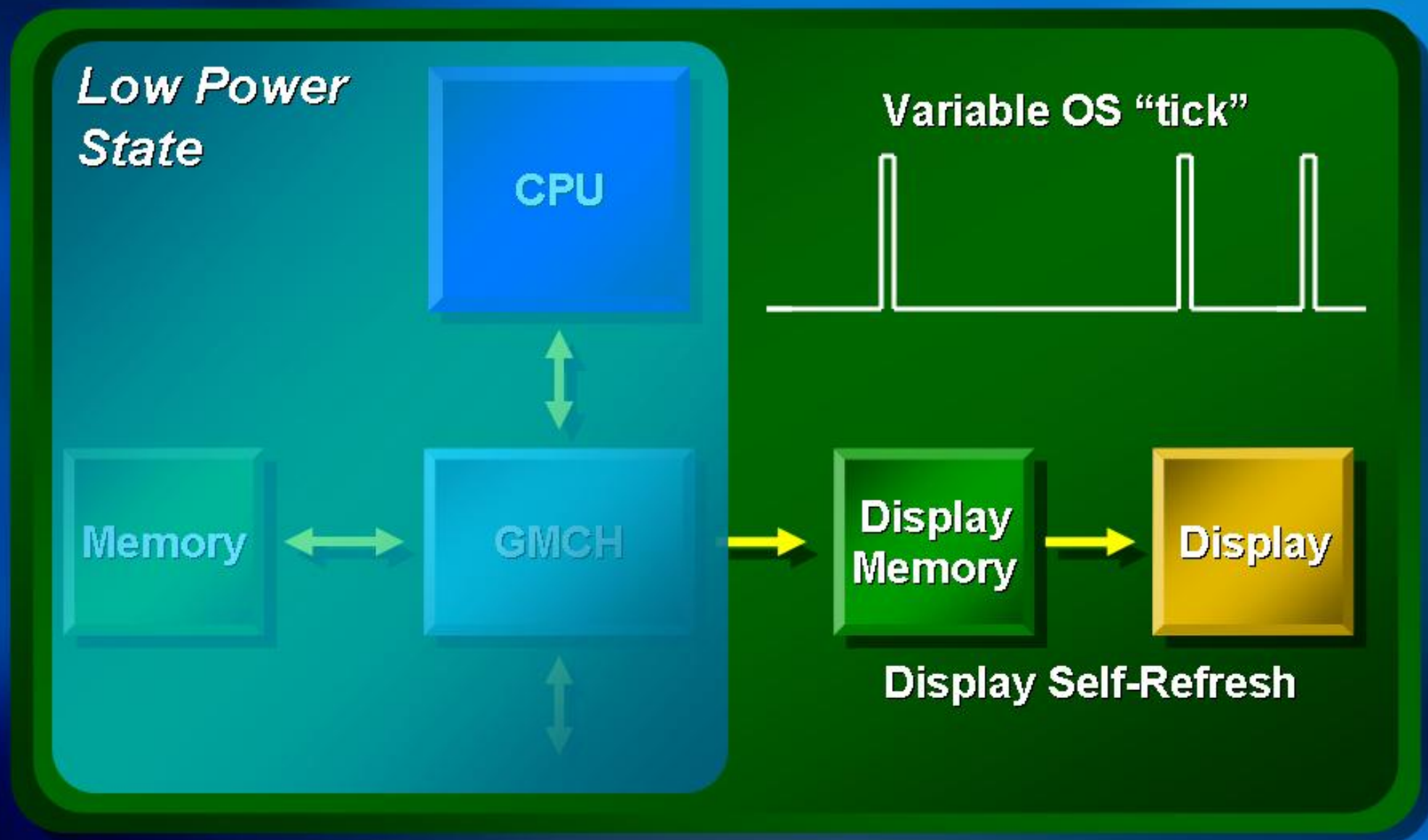
Based on power consumption running SPECint\_rate2000



# Today's Platform at Idle



# Improving Platform Idle Efficiency





# What Will it Take?

**Operating  
System**

**Communication  
and Storage**

**Platform  
Energy-Efficiency**

**Display**

**Standards**



# The Dawn of Energy-Efficient Performance

